

REMARKS

This is in response to the Official Action mailed May 8, 2002, in which claims 1-7 were rejected. A petition for a three-month extension of time, extending the time for response from August 8, 2002 to and including November 8, 2002, is enclosed herewith.

In the Official Action, the drawings were objected to because they did not include certain reference numerals indicated in the description. More specifically, reference numeral 326 was indicated in paragraph 44 of the present specification but not shown in the drawings. In addition, the drawings have been objected to because they include reference numerals not mentioned in the specification. In response, applicants have amended Fig. 5 to delete numeral 36', Fig. 11 to delete numeral 230, and Fig. 13 to delete numerals 329, 336 and also to add numeral 326. Applicants respectfully submit that reference numeral 256 is mentioned in the specification. Paragraph 43 states "compliant layer 256." Formal drawings incorporating these changes are enclosed herewith.

The specification was objected to, as the title was considered not to be descriptive. In response, Applicants have amended the title and assert that the new title is descriptive.

Claims 4-7 were rejected under 35 U.S.C. § 112, second paragraph as being indefinite. Specially, the Official Action states that "solder masses at at least some of said pairs" is unclear. Claim 4 requires solder masses at pairs of pads. As the assembly has a plurality of pairs of pads, claim 4 requires that at least some of the pairs have solder masses associated therewith. The solder masses are at at least some of the pairs. Thus, the use of "at" twice in this phrase is correct.

Claims 1, 4 and 5 were rejected under 35 U.S.C. § 102(b) as being anticipated by *Lakritz, et al.*, U.S. Patent No. 4,545,610 ("*Lakritz*"). Claim 1 is directed to a packaged

microelectronic element with contact pads and elongated solder columns. The elongated solder columns extend from the microelectronic element and are connected to terminals at the ends of the columns that are remote from the microelectronic element. The examiner asserts that *Lakritz* discloses elongated solder columns 38 extending from the microelectronic element 20 and terminals 12 connected to the columns. Claim 1 has been amended to require a flexible dielectric layer having terminals connected to the distal ends of the solder columns.

Lakritz discloses flip-chip bonding a semiconductor device 20 to a ceramic substrate 10. An example of the ceramic substrate is shown in U.S. Patent No. 4,245,273 to *Feinberg et al.* See Col. 3, lns. 4-22 of *Lakritz*. *Lakritz* discloses forming solder connections 38 by providing solder extensions on the substrate, providing solder mounds on the semiconductor device, and melting the solder extensions and solder mounds together. See Fig. 1 of *Lakritz*, step 7. and step 8. *Lakritz* does not disclose a package having a flexible dielectric layer. Thus, claim 1 is unanticipated by *Lakritz* and otherwise allowable.

Claim 4 is directed to a soldered assembly including solder masses at pairs of pads on first and second elements. Claim 4 requires that the solder masses incorporate "columnar inclusions therein" and that the columnar inclusions are oriented in the direction between the pads of the pair of pads. For example, a flexible dielectric sheet 20 having pads 28 is assembled with a semiconductor wafer 30 having contact pads 36 by disposing solder masses 40 between contact pads 36 and pads 28. See the present specification at paragraphs 27-29. The solder balls are melted, or partially melted. See paragraph 30. The sheet and wafer are displaced with respect to one another so that the solder masses 40 are stretched to form elongated solder columns 40'. See paragraph 32. The solder masses incorporate

columnar inclusions, which are present when the solder masses are stretched. "Columnar inclusion" is defined as a separate phase within the solder that is present as elongated droplets or particles. For example, the columnar inclusions may comprise solid inclusions within partially molten solder during the moving step. See paragraph 12. In another example, the solder masses are partially molten and include precipitates, which are present as solid bodies within the solder. The precipitates are orientated along the axis of elongation of the elongated solder mass. See paragraph 45.

Lakritz does not disclose columnar inclusions in the solder connections 38. Claim 4 is unanticipated by *Lakritz* and otherwise allowable. Claim 5 depends on claim 4. Thus, claims 1, 4 and 5 are unanticipated by *Lakritz* and otherwise allowable.

Claims 2 and 3 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Lakritz* in view of *Hoffman et al.*, U.S. Patent No. 5,578,869 ("*Hoffman*"). It is admitted in the Official Action that *Lakritz* does not disclose a dielectric packaging structure, as required by claim 2. *Hoffman* is cited for a dielectric layer. The Official Action states that the dielectric layer is disclosed at col. 6, lns. 60-63, which states that a dielectric layer is applied to a metallic substrate 26.

Hoffman discloses a semiconductor chip 10 connected to a component 20. The component comprises a metallic substrate 22 that is coated with an electrically non-conductive layer 24. Col. 4, lns. 18-24. The non-conductive layer 24 may be a thin layer of a polymer or a glass. Col. 4, lns. 58-62. The component 20 has circuit traces 26 with interior ends 30 and exterior ends 32. Solder bumps 34 on the interior ends 30 form connections with the pads 18 of the chip 10 and the exterior ends are connected to an external circuit. Col. 5, lns. 8-40.

The Official Action states it would have been obvious to utilize the dielectric layer disclosed by *Hoffman* on the semiconductor device of *Lakritz* to prevent shorting out. However, *Hoffman* discloses the dielectric layer as a coating on the metallic substrate. The microelectronic element is connected to the metallic substrate. *Lakritz* discloses connecting a semiconductor device to a substrate of a ceramic material utilizing the solder bonds discussed above. Col. 3, lns. 4-22.

There is no motivation to provide any dielectric layer on the semiconductor device 10 in *Lakritz*. There is no indication of any need to prevent shorting out of conductors on the semiconductor device in *Lakritz*. By contrast, *Hoffman* discloses a metallic substrate that carries conductive circuit traces 26. Thus, the non-conductive layer 24 is required to prevent shorting out of the substrate. There is no motivation to combine these references.

Claim 2 is directed to a dielectric packaging structure connected to the microelectronic element by the elongated solder columns. For example, the packaging structure may include a flexible dielectric sheet 20 including pads 28 that are connected to contact pads 36 of the microelectronic element by the elongated solder columns. See paragraph 27 and Fig. 1. *Lakritz* and *Hoffman* do not teach the subject matter of claim 2. Thus, for all the reasons discussed above, claim 2 is patentable over *Lakritz* in view of *Hoffman* and otherwise allowable.

Claims 6 and 7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Lakritz* in view of *Garner*, U.S. Patent No. 4,581,680 ("*Garner*"). Claim 6 depends from claim 4 and requires that the pads are offset from one another in a horizontal direction and that the elongated solder masses extend obliquely. The Official Action states that *Lakritz* discloses

that the pairs of pads are offset from one another in the horizontal direction. However, it is clearly shown in Fig. 2 that the pads of the semiconductor device 20 are located directly over the pads of the substrate 10.

The Official Action states that *Lakritz* fails to disclose elongated solder masses extending obliquely. *Garner*, U.S. Patent No. 4,581,680, ("*Garner*") is cited for solder masses that extend in an oblique direction. However, claim 4 requires columnar inclusions and, as discussed above, *Lakritz* fails to disclose the columnar inclusions required by claim 4. Claims 6 and 7 depend directly or indirectly upon claim 4. Thus, claims 6 and 7 are patentable over *Lakritz* in view of *Garner* for the reasons discussed above.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with markings to show changes made."


As it is believed that all of the rejections set forth in the Official Action have been fully met, favorable reconsideration and allowance are earnestly solicited.

If, however, for any reason the Examiner does not believe that such action can be taken at this time, it is respectfully requested that she telephone Applicants' attorneys at (908) 654-5000 in order to overcome any additional objections which he might have.

If there are any additional charges in connection with this requested amendment, the Examiner is authorized to charge Deposit Account No. 12-1095 therefor.

Dated: November 7, 2002

Respectfully submitted,

By 
Kimberly V. Perry
Registration No.: 43,612
LERNER, DAVID, LITTENBERG,
KRUMHOLZ & MENTLIK, LLP
600 South Avenue West
Westfield, New Jersey 07090
(908) 654-5000
Attorneys for Applicant

Version With Markings to Show Changes Made

MARKED-UP COPY OF AMENDED TITLE

Please amend the title to MICROELECTRONIC PACKAGES
WITH ELONGATED SOLDER INTERCONNECTIONS

MARKED-UP COPY OF AMENDED CLAIMS:

1. (Amended) A packaged microelectronic element
comprising:

(a) a microelectronic element having a front surface
with contact pads thereon;

(b) elongated solder columns extending from said
front surface of said microelectronic element, said columns
having distal ends remote from said microelectronic element; and

(c) a flexible dielectric layer having terminals
connected to said distal ends of said solder columns.

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